NUCLEAR STRUCTURE BEYOND THE PROTON DRIP LINE

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The proton drip–line has been mapped extensively in recent years, and a new form of radioactivity was discovered, in nuclei lying beyond the proton drip-line with charges between 50 and 84. Protons can be emitted from the ground or isomeric states, and fine structure for decay to an excited 2^+ state of the daughter nucleus was also observed. Due to the large Coulomb barrier, and the very small escape energy, the proton is in a resonance state very low in the continuum, corresponding to a single particle excitation.

The shape of proton radioactive nuclei, ranges from spherical or quasi spherical up to very large deformations. In the deformed case, Decay can be studied in terms of Nilsson resonances that describe the outgoing proton, and the daughter nucleus can be considered in the strong coupling limit, as having an infinite momenta of inertia. It is possible to go beyond this approach, and include the rotational spectrum of the daughter nucleus. However, in this case, it is indispensable to take into account exactly the pairing residual interaction, leading to a treatment of the Coriolis coupling in terms of quasi–particles.

All available experimental data on odd–even and odd–odd deformed proton emitters from the ground and isomeric states, and fine structure, can be accurately and consistently reproduced. The calculation provides valuable nuclear structure information on deformation and angular momentum J of the decaying nucleus, and on the state of the unpaired neutron in odd–odd nuclei, giving unambiguous assignments to the decaying states.